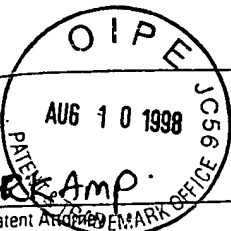


#15

To:



N. HERKAMP

Patent Attorney



# GE Aircraft Engines Invention Disclosure

General Electric Company

## For Legal Operation Use

Docket Number

13 DV-1214-2

Date Opened

May 14, 1994

By

N. Herkamp

☒ H17, Evendale☐ 16004, Lynn

MAY 13

## Instructions

1. Using the outline given below, describe the invention fully and completely. Use as many or as few sheets as necessary for an adequate disclosure.
  - A. **TITLE.** Please provide a short title of the invention.
  - B. **PRODUCT.** Indicate the product line(s) to which the invention pertains (including engine designation(s) where appropriate).
  - C. **BACKGROUND.** Describe the prior art (such as patents or publications) including limitations and/or problems existing therein which led to the invention and attach a copy of such prior art.
  - D. **DESCRIPTION AND OPERATION.** Describe the basic structure and operation of the invention, with parts referenced by numbers on attached illustration(s) preferably no larger than 8 1/2 x 11.
  - E. **ADVANTAGES AND NEW FEATURES.** List the advantages and new features of the invention not found in the prior art.
  - F. **ALTERNATIVES.** Describe and illustrate alternative forms of the invention.
  - G. **EXECUTION OF DISCLOSURE.** Using the format illustrated below,

**EACH INVENTOR:** Must **Sign and Date Each** page of the disclosure and **Each** sheet of any illustrations; and

**TWO WITNESSES:** Must read, understand and **Sign and Date Each** page of the disclosure and **Each** sheet of any illustrations.

Inventor's Signature

Date

*[Signature]* 4/25/94

Witnessed, read, understood and signed by

Date

*[Signature]* 4/25/94  
*[Signature]* 4/25/94  
*[Signature]* 5/12/94

2. Send **Original and Eight (8) Copies** of the Invention Disclosure and any attached illustrations to the appropriate patent attorney.

## 3. Print or Type

Inventor

Inventor

Inventor

Full Name

S.R. MANNAVA

Social Security Number

061-38-7041

Mail Drop

D83

Telephone Number

3-9416

Department

M &amp; Q TD

4. **EACH INVENTOR MUST FURNISH THE INFORMATION REQUESTED ON THE REVERSE SIDE OF THIS FORM.**

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<b>To:</b> <u>N. Herkamp</u> Patent Attorney <input checked="" type="checkbox"/> H17, Evendale <input type="checkbox"/> 16004, Lynn	 <b>GE Aircraft Engines</b> <i>Invention Disclosure</i> General Electric Company	<b>For Legal Operation Use</b> Docket Number
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Inventor's Signature <u>Herbert Halika</u>	Date <u>4/22/94</u>	Witnessed, read, understood and signed by <u>Ralph Jones</u>	Date <u>5/2/94</u>
		<u>[Signature]</u>	<u>5/2/94</u>
		<u>N. Herkamp</u>	<u>5/12/94</u>

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3. Print or Type	Inventor	Inventor	Inventor
Full Name	HERBERT HALIKA		
Social Security Number	130-32-2354		
Mail Drop	X412		
Telephone Number	(513) 552-4385	243 281	
Department	FAN & COMP. AIRFOILS CENTR. OF EXCELLENCE	2944	

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4/26/94 #15

This note is included for clarification purposes on charging practices for H. Halia connected with the Laser Shock Peening Invention .

H. Halia's time was allocated over the following component numbers during the time frame referenced on the Invention Disclosure form:


5339	CFM56
5252	LM2500
5250	CF6 Fan
5253	CF6 HPC
5392	WCFB
5354	F101/F110 Fan
5338	F101/F110 HPC

As a result, cost were allocated over numerous programs including military contracts. Due to the extent of the allocation base however, it would not be feasible to identify specific contracts impacted.

The component numbers indicated on the Invention Disclosure form are an indication of what specific programs were involved in the actual performance of work, not an indication of cost charging.



S. Behrends  
Airfoils COE Finance

<b>To:</b>  <u>N. HERKAMP</u> Patent Attorney  <input checked="" type="checkbox"/> H17, Evendale <input type="checkbox"/> 16004, Lynn	 <b>GE Aircraft Engines</b> <i>Invention Disclosure</i> <hr/> General Electric Company	<b>For Legal Operation Use</b>	
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Inventor's Signature <u>J.E. Rhoda</u>	Date <u>5-2-94</u>	Witness read, understood and signed by <u>James H. Drenge</u> <u>N.E. Herkamp</u>	Date <u>5/2/94</u> <u>5/2/94</u> <u>5/12/94</u>
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3. <b>Print or Type</b>	Inventor	Inventor	Inventor
Full Name	<u>J.E. Rhoda</u>		
Social Security Number	<u>333-32-3837</u>		
Mail Drop	<u>J40</u>		
Telephone Number	<u>3-3338</u>		
Department	<u>CHIEF Eng. office</u>		

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<b>To:</b> <u>N. HERKAMP</u> Patent Attorney <input checked="" type="checkbox"/> H17, Evendale <input type="checkbox"/> 16004, Lynn	 <b>GE Aircraft Engines</b> <i>Invention Disclosure</i> General Electric Company	<b>For Legal Operation Use</b>	
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Inventor's Signature	Date	Witnessed, read, understood and signed by	Date
<u>Harry Jacobs</u>	<u>4/28/94</u>	<u>Arthur Pichonchi</u>	<u>4/28/94</u>
		<u>J. Petriche</u>	<u>4/28/94</u>
		<u>N.D. Herkamp</u>	<u>5/12/94</u>

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3. <b>Print or Type</b>	Inventor	Inventor	Inventor
Full Name	<u>L. JACOBS</u>		
Social Security Number	<u>278-38-3474</u>		
Mail Drop	<u>520</u>		
Telephone Number	<u>552-5157</u>	<u>293 3589</u>	
Department	<u>M &amp; I PEO</u>		

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Inventor's Signature	Date	Witnessed, read, understood and signed by	Date
<u>E. A. Rainous</u>	<u>5/10/94</u>	<u>[Signature]</u>	<u>5-11-94</u>
		<u>A. J. Pichinski</u>	<u>5-11-94</u>
		<u>N. D. Herkamp</u>	<u>5/12/94</u>

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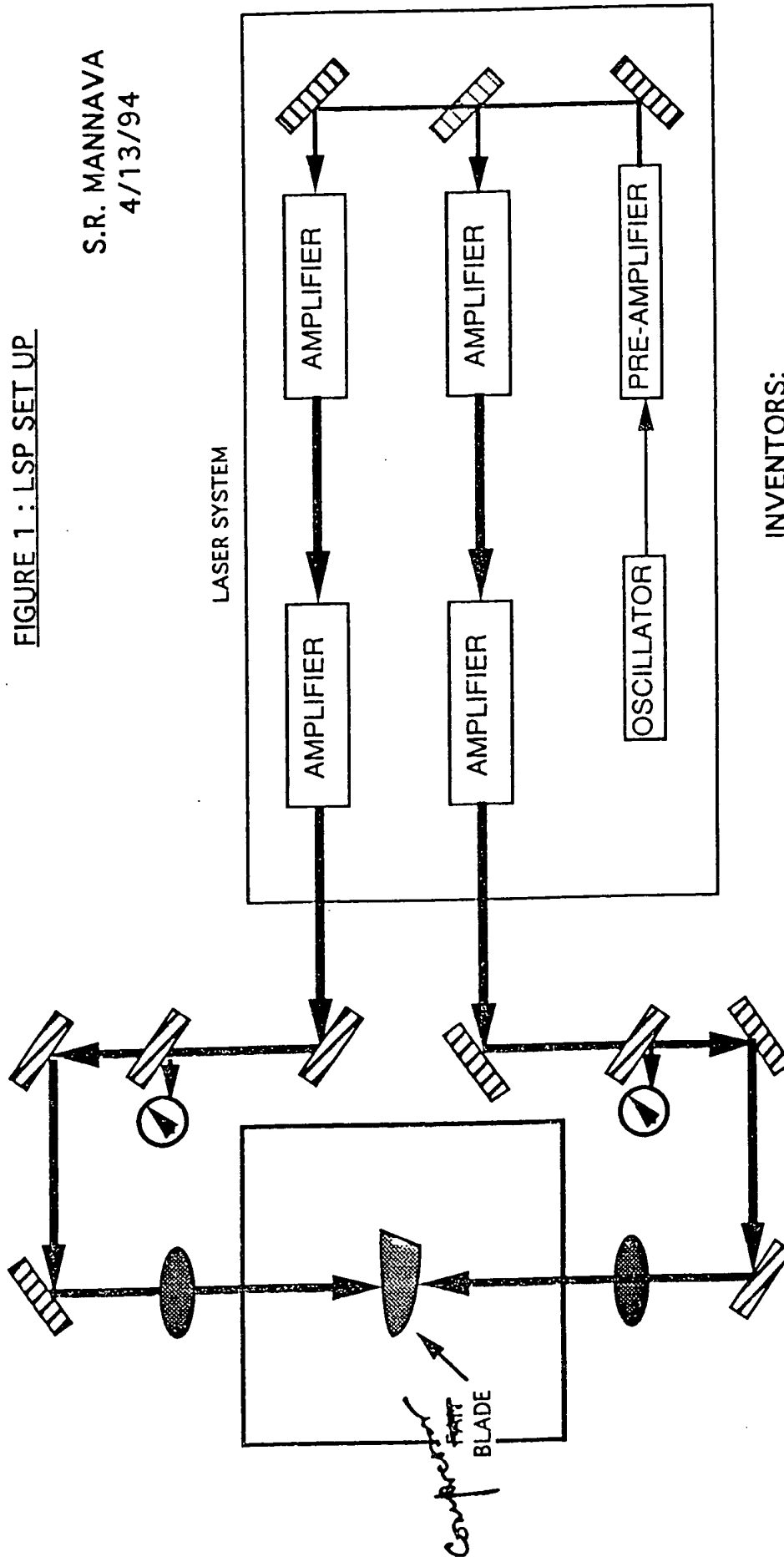
3. Print or Type	Inventor	Inventor	Inventor
Full Name	<u>Edward A. Rainous</u>		
Social Security Number	<u>303-66-5506</u>		
Mail Drop	<u>520</u>		
Telephone Number	<u>552-5566</u>		
Department	<u>M&amp;IPEO</u>		

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# INVENTION DISCLOSURE BRIEF - ENHANCED COMPRESSOR BLADE FOR AIRCRAFT ENGINES

FIGURE 1 : LSP SET UP



S.R. MANNAVA  
4/13/94

INVENTORS:

4/25/94

4-25-94

4/25/94

4/25/94

4/25/94

WITNESSES:

4/25/94

4/13/94

Invention Disclosure Brief  
Enhanced Compressor blades for Aircraft Engines

Mammar  
 Unila  
 Rhody  
 Jacobs  
 FOD

**Abstract:**

High Pressure compressor blades are susceptible to Foreign Object Damage (FOD). causes nicks and tears in leading and trailing edges of airfoils. These nicks and tears become the source of high stress concentrations and severely limit the life of these blades in High Cycle Fatigue (HCF). Severe FOD damage may also result in a loss of engine due to release of failed blade.

The present solution to this problem is to design for stress concentration margins on the airfoil edges. In some cases a solution is to manage the dynamics of the blade by using dampers. Dampers are expensive and may not protect blades from very severe FODs.

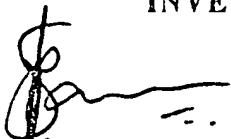
This invention is about an alternate solution to the FOD problem. Compressor blades can be Laser Shock Peened (LSP) to impart deep compressive layers at selective locations on the blade without causing any surface damage. These compressive layers will increase the HCF strength of the blade in the presence of nicks and tears to a higher value perhaps depending on the conditions equal to base metal strength which ensures design life.

The concept is equally valid to new or repaired compressor blades. Selected locations on the blade can be LSPed and the resulting effects can be taken in to account in the design.

The concept has been demonstrated. The entire leading edge of LM5000 Fan blade has been LSPed and HCF tested in flex mode. Results show the HCF strength in the presence of simulated severe FOD damage is approximately equal to the base line value of undamaged blades.

Figure 1 shows LSP setup used for LM5000 compressor blade demonstration. A laser beam is split into two, amplified in several stages and are focused on either side of fan blade. Both sides of the blade are to be treated simultaneously to control blade distortion. The blade is traversed to treat the required area of the blade. Figure 2 shows HCF test results for flex mode. After the blade was LSPed it was nicked and tested. Failure stress values were recorded for runout conditions. A strain gage installed near nicked location was used to monitor the blade vibrational frequency.

**INVENTORS:**

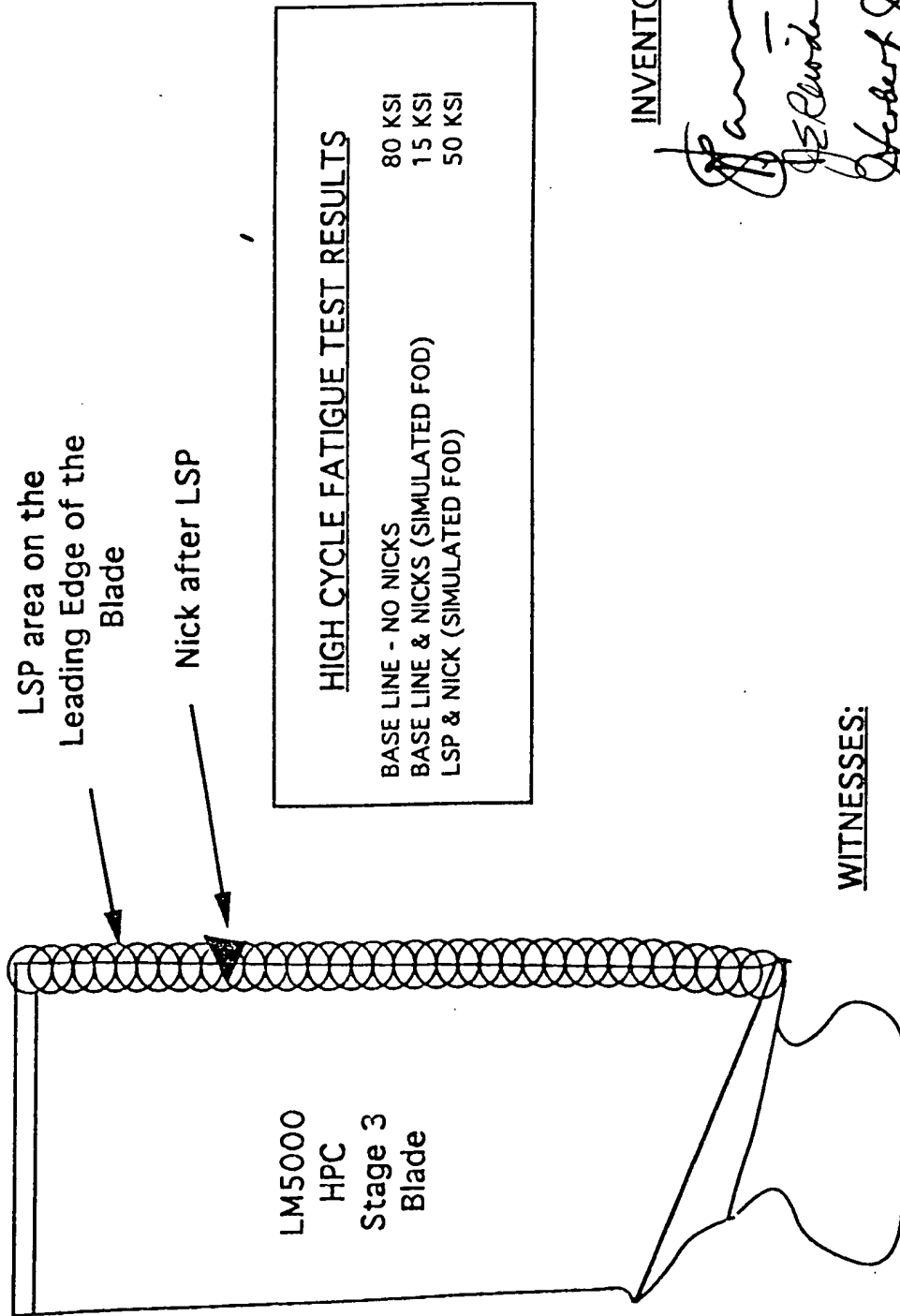
 4/25/94  
 J. Ellwood 4-25-94  
 Herbert Walby 4-25-94  
 Larry Jacobs 4-25-94  
 E. G. Raison 4/25/94

**WITNESSES**

Stacy Auer 4/28/94  
 John M. [unclear] 4/28/94  
 W. D. Kerling 5/12/94



FIGURE 2: TEST RESULTS



WITNESSES:

Steve Allen 4/25/94

INVENTORS:

Sam 4/25/94  
DeLuca 4-25-94  
Robert Dabala 4/25/94  
Larry Jacobs 4/25/94  
C. E. Kacivaz 4/25/94